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(57) Abstract

Clear labels for bottles, cans, jars and the like are made from a combination of polypropylenes and one or more hydrocarbon resins. The labels are based on films made from the combinations and have physical properties that render them particularly useful for automated bottling operations. Specifically, the films upon which the labels are based have physical properties that lead to excellent die–cuttability, and dispensing, without matrix break, streamers, or other properties that can impede the speed of the automatic bottling operation. Additionally, the films are conformable to bottle shapes at application speeds that are economically attractive. The surface tension of such labels leads to a greater ease of printing and/or metallization.

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DIE-CUTTABLE LABELS

TECHNICAL FIELD

This invention relates generally to die-cuttable, conformable labels made from specific polypropylene films. More specifically this invention is directed toward labels rendered die-cuttable and conformable by using polypropylene films based on polypropylene hydrocarbon resin combinations.

BACKGROUND

Clear labels for bottles are generally sought that can be both die-cuttable on a liner stock and while being dispensed have a high degree of comformability to the contours of a bottle, jar can or the like. Because the process of filling and labeling bottles, cans, jars and the like must be highly automated and attain high speed to keep economics of the bottling process favorable, and because the labels must be applied with substantially no wrinkles, covering any and all contours and design embellishments, the films from which such labels are made must have properties that facilitate these label applying demands. Specifically, films for labels must have the ability to be printed, accept an adhesive, must be easily die-cut, dispensed, and very conformable.

Earlier attempts to provide polyolefinic films to adequately satisfy all these demands have fallen short for a variety of reasons. For instance, while biaxially oriented polypropylene (BOPP) films have excellent clarity and gloss, and are die-cuttable, their relatively high stiffness (as measured by 1% secant modulus) is such that the labels made therefrom do not readily conform to contours without wrinkling.

On the other hand, cast polypropylene films (without substantial added orientation) have a relatively low modulus and are therefore very conformable, their die-cuttability is not acceptable for high speed operations, with clean, non stringing die cuts.

So called "MDO" films, which are generally cast films with a degree of orientation added in the machine or MD direction, fail to provide satisfactory label

material, as while they can generally be successfully die-cut, their conformability is not satisfactory and the clarity may not be up to "clear label" standards.

There is a commercial need therefore for clear, conformable, die-cuttable, easily dispensed, printable labels made from polypropylene film.

SUMMARY

I have discovered that making label stock from certain polypropylene combinations will provide a label that is die-cuttable, clear, very conformable, printable, and dispensable with excellent clarity. The labels or label stock are made from certain polypropylenes, including polypropylene/hydrocarbon resin blends that are extruded via the cast technique, without added orientation. The combination of the resulting film's clarity, ultimate tensile strength, ultimate elongation, and 1% secant modulus, surprisingly and unexpectedly provides the subsequently made labels with ease of die-cuttability, a high level of conformability, high clarity, excellent dispensability and printability. Labels made from films having the broadest range of properties as outlined below will meet this high combination of demands:

(The numbers in parenthesis after the described properties corresponds to data in Table 1.)

Tensile at yield (1)

MD (machine direction) 2-6 K psi

TD (transverse or cross direction) 2-6 K psi

Ultimate Tensile (2)

MD 4-12 K psi

TD 4-12 K psi

Ultimate elongation (4)

MD 200-950%

TD 200-950%

1% Secant Modulus (3)

MD 80-250 K psi

TD 80-250 K psi

Haze 1-4%

Gloss 80-90%

The foregoing aspects, features and advantages of the present invention will become clearer and more fully understood when the following detailed description, and appended claims are read.

DETAILED DESCRIPTION

Introduction

This invention concerns certain clear label materials made from a selected group of polypropylene combinations.

In certain embodiments of the present invention, labels of polypropylene film combinations containing amounts of certain hydrocarbon resins are shown to have a unique set of physical properties. The resulting labels have combinations of properties rendering them superior and unique to labels previously available. The polypropylene/polypropylene hydrocarbon resin combination films disclosed herein are particularly well suited for use in producing certain classes of clear labels. Such labels include, but are not limited to bottle labels, can labels, jar labels and the like made using one or more of the films disclosed herein. Additionally the labels of the present invention may also be used in metallized labels using techniques well known in the art.

Following is a detailed description of certain preferred polypropylene films, and labels made from these films. Those skilled in the art will appreciate that numerous modifications to these preferred embodiments can be made without departing from the scope of the invention. For example: Though the properties of labels made from 2-3.0 mil films of polypropylene/polypropylene hydrocarbon blend combinations, specifically such combinations including 5 to 20% by weight hydrocarbon resin are exemplified in clear label applications, they will have numerous other uses and the combinations may be formed from other materials. To the extent that the description below is specific, it is solely for the purpose of illustrating preferred embodiments of this invention and should not be taken as limiting the present invention to these specific embodiments.

Polypropylene

Polypropylenes for use in certain embodiments of my invention include homopolymer and copolymer polypropylenes. The homopolymer or copolymer materials should preferably have a melt flow rate (MFR) in the range of 2-15 dg/min.

The copolymer materials for use in the present invention will usually be selected from copolymers of propylene and ethylene, with inclusion of ethylene at 1-5 weight percent, preferably 2-4 weight percent, more preferably 2-3 weight percent. Copolymers of other alpha-olefins having 4-20 carbon atoms are also contemplated as well as terpolymers of propylene, ethylene and one or more of the alpha-olefins. The preferred polypropylenes will have a MFR in the range of 2-15 dg/min., preferably 3-12 dg/min., more preferably 5-7 dg/min.. The polypropylene portion of my combination will be present in the combination in the range of from 5-30, preferably 5-25, more preferably 5-20, more preferably 10-20 weight percent based on the total weight of the polypropylene/polypropylene hydrocarbon resin blend combination.

Polypropylene Hydrocarbon Resin Blend Material

Polypropylene hydrocarbon resin blends are commercially available. Discussion of such hydrocarbon resin properties are contained in US patents 5,213,744 and 4,911,749 incorporated herein by reference for purposes of US patent practice. In general the blends should have a hydrocarbon resin content in the range of from 1-25, preferably 2-20, more preferably 5-20, most preferably from 10-20 weight percent hydrocarbon resin, based on the total polypropylene and hydrocarbon resin. The polypropylene hydrocarbon resin blends should have a MFR in the range of from 10-40, preferably 12-30, more preferably 15-25 dg/min. The propylene hydrocarbon resin blends will be present in said combinations in the range of from 70-95 weight percent, preferably 75-95, more preferably 80-95, most preferably 80-90 weight percent based on the total weight of the combination.

Combinations of Polypropylene and Polypropylene-Hydrocarbon Resin Blends

Combinations of the materials discussed above, while desirable, are not imperative. The combinations should have a combined melt flow rate to facilitate extrusion into a film. The combination should preferably have a total or over all inclusion of hydrocarbon resin in the range of from 5-25, preferably 8-20, more preferably 8-15 weight percent hydrocarbon resin based on the total weight of the combination. While random copolymer polypropylene is used in the polypropylene portion of the combination in the examples which follow, different copolymers or even homopolymers may be used.

Additionally, while polypropylene homopolymers are used in the polypropylene hydrocarbon resin blend, copolymers may also be used.

The overriding principle when selecting such materials and extruding them, should be that the combinations have relatively easy processability (into a film) and most importantly, the components of the combination should be present at effective amounts that render the film useable in high speed labeling operations by having the unique combination of properties discussed below. That is the materials, when combined should not only be processable into film, but have clarity, die cuttability, easy dispensability, printability and conformability, but should have the underlying property combinations discussed, for example, clarity, ultimate tensile strength, ultimate elongation, and 1% secant modulus.

Physical Properties of the Combination

Films made from the combinations discussed above, which are subsequently made into labels will have a unique set of physical properties, the combination of which render the films particularly suitable for label manufacture and application. The physical properties and the methods for determining them are related below.

Tensile at Yield in pounds per square inch (PSI) (ASTM D882 at non humidity control)

Ultimate Tensile in psi (ASTM D882 at non humidity control)

Ultimate Elongation % differing from ASTM D882 by having an initial jaw separation of 1" and a separation speed of 5"/minute.

1% Secant Modulus psi (ASTM D882 at non humidity control)

Haze % ASTM D-1003

Gloss % ASTM D2457

Treatment Level dynes/cm^2

Tensile at yield will range from 2-10 K psi, preferably 2-8 K psi, more preferably 3-6 K psi, in both MD and TD tests.

Ultimate Tensile in psi 2-10 psi, preferably 3-9 psi, more preferably 5-8 psi (both MD and TD)

Ultimate Elongation 300-950%, preferably 350-900, more preferably 400-900, most preferably 500-800% (both MD & TD)

1% Secant Modulus MD & TD 75-250 K psi, preferably 90-225 K psi, more preferably 100-200 K psi, most preferably 125-175 K psi

Haze 0.5-6, preferably 1-5, more preferably 1-4%, most preferably 1-3%

Gloss 60-95, preferably 65-90, more preferably 75-90 most preferably 80-90%.

Treat Level or surface tension 36-42, preferably 37-41, more preferably 38-41, most preferably 39-41 dynes/cm^2.

Production of the Films

Films contemplated by certain embodiments of the present invention may be made utilizing the polypropylene/hydrocarbon resin blend combinations discussed supra, by processes including, blown and cast, preferred is a cast film process. In such extrusion processes, the films of the present invention can be formed into a single layer film, or may be one layer or more of a multi-layer film or film composite. Films of the present invention may also be included in laminated structures especially coated or laminated adhesive. As long as a film, multi layer film, or laminated structure includes one or more polypropylene/polypropylene hydrocarbon resin blend combination film layers having the desirable physical properties of the film, in the ranges described above, it will be understood to be contemplated as an embodiment of the present invention. By the term "no intentionally added orientation" I intend that traditional film forming techniques include drawing a molded polymer from a die gap usually greater in thickness than

the final film thickness. Such drawing adds a degree of orientation. "No intentionally added orientation" means no further orientation is added.

Polyolefin Component

There are a variety of commercial and experimental polypropylene and polypropylene hydrocarbon resin blend combinations useful in the manufacture of films included in certain embodiments of the present invention. A non-inclusive list is found below along with the general bulk resin properties published:

TABLE A

Commercial Designation	Density g/cm^3	Melt Flow g/10 min.	Type
PP9012 E1	0.900	6.0	PP/Ethylene
PP 9263	0.900	6.0	PP/Ethylene
PP 9524	0.900	11.0	PP/Ethylene
PP 9513	0.900	7.0	PP/Ethylene
PP 6124*	0.930	21.0	

* 85% polypropylene homopolymer, 15% hydrocarbon resin blend

All of the above available from Exxon Chemical Company, Houston, TX

EXAMPLES

All films of the following examples are of nominal 2-2.5 mil thickness.

Example 1 - 5

Example 1 is fabricated from Escorene™ PP6124, a nominal 20 MFR , 85% polypropylene homo polymer, 15% hydrocarbon resin blend present in the combination at 80%, and Escorene™ PP-9012, a nominal 6 MFR random (ethylene) copolymer polypropylene, present in the combination at 20% by weight. The film is made on a 150 mm Reifenhauser cast extrusion line at normal processing conditions processing conditions listed in Table 1a.

Example 2 uses 100% Escorene™ PP-9012

Example 3 is a commercially available BOPP Mobil Label-Lyte® 155LL-434

Example 4 is a commercially available Machine Direction Oriented (MDO) film; and

Example 5 uses 100% of the Escorene™ PP6124 which was subsequently treated at a standard power level corona discharge. At the standard power level,

the combination film shows classic signs of over treatment, such as back treat and some pucker or wrinkle. When the treat level was backed off slightly to eliminate the over treat symptoms, the resulting films exhibited higher treat (lower surface tension) than is achievable with the other cast films, indicating a more receptive surface for printing and/or metallization.

As can be seen from the Table 1 the film of Example 1, through its unique set of physical properties, makes a film that is both extremely die-cuttable and very conformable, while Example 2, the commercially available cast polypropylene film, is highly conformable, but not easily die-cuttable. Example 3 by further contrast, has excellent die-cuttablility but low comformability.

TABLE 1

Property	Example 1*	Example 2	Example 3	Example 4	Example 5
(1) MD Yield, psi	4,200	4,800	5,500	24,000	5000
(1) TD Yield, psi	4,100	4,200	14,166	3,300	4800
(2) MD ULT, psi	7,600	8,600	18,955	24,000	5500
(2) TD ULT, psi	6,200	7,000	37,741	2,500	5300
(3) MD 1%, psi	153,000	80,000	250,000	204,000	200,000
(3) TD 1%, psi	157,000	81,000	400,000	128,000	200,000
Haze, %	1.8	3.5	3.0	5.8	1.5
Gloss, %	88	80	85	87	90
Treat, Dynes/cm^2	38	35	38	--	38
(4) MD Elong, %	650	1,000+	141	60	200
(4) TD Elong, %	710	1,000+	47	1,000+	100
Thickness, mills	2.00	2.00	2.00	3.00	2.00

TABLE 1a

Extrusion Conditions

Example 1

Condition	2.00 MIL	2.50 MIL
Ext. RPM	80	70
Cast Roll, fpm	228	165
Melt Temp., °F	453	450
Melt, psi	1670	1690

CLAIMS

I claim:

1. A label being clear, die-cuttable, conformable, and printable, comprising a film, said film having:

a) tensile at yield, MD & TD in the range of from 3-6 Kpsi;

b) ultimate tensile MD & TD in the range of from 5-8 Kpsi;

c) ultimate elongation MD & TD in the range of from 400-900%;

d) 1% secant modulus MD & TD in the range of from 100-200 Kpsi;

e) haze in the range of from 1-3%; and

f) gloss in the range of from 80-90%;

2. The label of claim 1 wherein said film includes a combination of polypropylene and a polypropylene hydrocarbon resin blend wherein said combination includes in the range of from 5-30, preferably 5-25, more preferably 5-20% by weight of a polypropylene selected from one of polypropylene homopolymer, polypropylene copolymer, or blends thereof, and in the range of from 70-95, preferably 75-95, more preferably 80-95% by weight of a combination of polypropylene and a hydrocarbon resin, wherein said hydrocarbon resin is present in said film in the range of from 5-25, preferably 8-20, more preferably 8-15 % by weight based on the total weight of said film.

3. The label of claims 1 or 2 wherein said film has an ultimate elongation MD & TD in the range of from 500-800%; a 1% secant modulus MD & TD in the range of from 125-175 Kpsi; and a surface tension of 36-42 dynes/cm^2.

4. The label of any of the preceeding claims wherein said film has a surface tension in the range of from 39-41 dynes/cm^2, preferably 37-41, more preferably 38-41 dynes/cm^2, most preferably 39-41 dynes/cm^2.

5. Use of the label of any of the preceeding claims to label a clear bottle.

6. A clear bottle comprising:

a) a bottle; and

b) a clear, conformable, die-cuttable label, said label including a film, said film comprising in the range of from 5-25 weight % of a polypropylene selected from the group consisting of polypropylene homopolymer, polypropylene copolymer, and combinations thereof and in the range of from 95-75 % by weight of a combination of polypropylene and a hydrocarbon resin, wherein said hydrocarbon resin is present in said film in the range of from 5-25 % by weight based on the total weight of said film, wherein said film has a treat level of 39-41 dynes/cm^2.

said film having

i) tensile at yield MD & TD in the range of from 2-10 Kpsi;

ii) an ultimate tensile MD & TD in the range of from 2-10 psi;

iii) 1% secant modulus MD & TD in the range of from 75-250 Kpsi; and

iv) a haze in the range of from 1-5%.

7. The clear bottle of claim 6, wherein said film has

a) tensile at yield MD & TD in the range of from 3-6 Kpsi;

b) ultimate tensile, MD & TD, in the range of from 5-8 psi;

c) ultimate elongation MD & TD in the range of from 400-900%;

d) 1% secant modulus MD & TD in the range of from 125-175 Kpsi; and

e) haze in the range of from 1-3%.

8. The clear bottle of any of claims 6 or 7, wherein said film has a surface tension in the range of from 39-41 dynes/cm^2.

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
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Minimum documentation searched (classification system followed by classification symbols)
IPC 6 C08J B32B G09F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 5 212 009 A (PEIFFER HERBERT ET AL) 18 May 1993 see the whole document ---	1-8
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A	US 4 921 749 A (BOSSAERT BERNARD L L ET AL) 1 May 1990 cited in the application see the whole document ---	1-8
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA	Authorized officer
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	WO 96 21563 A (AVERY DENNISON CORP) 18 July 1996 see the whole document ---	1-8
A	WO 96 32441 A (EXXON CHEMICAL PATENTS INC) 17 October 1996 see table III -----	1

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